



ETSI
TECHNICAL
REPORT

ETR 345

January 1997

Source: ETSI TC-HF

Reference: DTR/HF-02009

ICS: 33.020

Key words: Keypad, MMI, PWSN, terminal

**Human Factors (HF);
Characteristics of telephone keypads and keyboards;
Requirements of elderly and disabled people**

ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE

Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE

X.400: c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

Tel.: +33 4 92 94 42 00 - Fax: +33 4 93 65 47 16

Copyright Notification: No part may be reproduced except as authorized by written permission. The copyright and the foregoing restriction extend to reproduction in all media.

© European Telecommunications Standards Institute 1997. All rights reserved.

Contents

Foreword	5
Introduction	5
1 Scope	7
2 References	7
3 Definitions, symbols and abbreviations	7
3.1 Definitions	7
3.2 Symbols	8
3.3 Abbreviations	8
4 Recommendations for the characteristics of telephone keypads and keyboards	8
4.1 Keypad layout	9
4.2 Size of keys.....	9
4.3 The space between each key	9
4.4 Separation of key groups	10
4.5 Shape of keys	10
4.6 Key tops	10
4.7 Height of characters on the keys	10
4.8 Contrast between characters and keys	10
4.9 Contrast between keys and telephone set.....	10
4.10 Key material	11
4.11 Tactile feedback and ease of keying	11
4.12 Angle of keypad	11
4.13 Labelling of function keys.....	11
4.14 Activation of functions.....	12
4.15 Labelling of memory keys	12
Annex A: Bibliography	13
History.....	14

Blank page

Foreword

The Technical Committee for Human Factors (TC-HF) of the European Telecommunications Standards Institute (ETSI) has prepared this ETSI Technical Report (ETR) on the characteristics of telephone keypads required by elderly and disabled people.

Introduction

In Europe, the creation of a single market generally makes standardization more important than ever in order to promote free trade over the borders of European countries. However, standardization also has an impact on the usability of products and services, which is why it is important that standards meet the needs and requirements of users of products and services.

Elderly and disabled people constitute about a quarter of the population in Europe (Europe in figures [1]), and even though they do not all have requirements for standards which are different from the rest of the population, they form a considerable part of the population that must be catered for when standards are developed.

Rapid technological development has resulted and will result in many new technological products and services. These may either ease the lives of elderly and disabled people or, if standards for new products and services do not meet the requirements of these groups, they may create barriers that exclude elderly and disabled people from taking part in society on equal terms with the rest of the society.

The basic means for access to telecommunications are telephone keypads. Even though new solutions for access to terminals occur, e.g. screen based windows solutions or speech recognition, keypads will probably continue to be the basic means of access for a long time. However, even in recent types of telephone terminals, the keyboard is not always designed for maximum usability. An example of this is mobile telephones where the functionality of the keypads in many cases is rather poor, even for people who do not have any impairments.

In order to design telephone keypads for all, requirements for telephone keypads must be stated. Unfortunately only little is documented about elderly and disabled users' requirements of telephone keypads. Therefore a study of such requirements has been carried out by the Danish Centre for Technical Aids for Education and Communication in co-operation with representatives of various disabled people's organizations. The study included a user panel test where 54 people with varying degrees of disability participated.

The project was part of the Technology Initiative for Disabled and Elderly people (TIDE) Horizontal European Activities in Rehabilitation Technology (HEART) study on user influence in standardization [2]. The results indicate that the requirements of elderly and disabled people may be included in conventional telephone keypads providing access to telecommunications services for a large range of elderly and disabled users. In other words it is possible to design for all.

The results from this research provide some of the basis for the present recommendations for telephone keypad and keyboard characteristics.

The intended users of this ETR are shown in table 1.

Table 1: Intended users and potential benefits

	User	ETR used for	Potential Benefit
1	Terminal manufacturers and procurers	Defining requirements for the manufacture or procurement of terminals	Reduced mislaying and dialling errors, reducing non-revenue earning network utilization
2	Users organizations	Assistance in the assessment of terminals suitable for elderly and disabled people	Reduced errors in recommending terminals for elderly and disabled people
3	Product designers	Providing design requirements for a wider or specialized customer base	Reducing design errors

Blank page

1 Scope

This ETSI Technical Report (ETR) gives recommendations about the physical characteristics of telephone keypads and keyboards which correspond to the requirements of elderly and disabled people. Keypads and keyboards designed to meet these recommendations should more easily give access to telecommunications services for a significant proportion of the population, i.e. including people with certain disabilities.

The ETR is intended to apply to table-top and wall-mounted telephones, including payphones. This document is not specifically intended to apply to text telephones, mobile phones or cordless phones, but the recommendations may be applied where considered appropriate.

2 References

- [1] Eurostat (1992): "Europe in figures" (3rd Edition), Luxembourg, Office for Official Publications of the European Community.
- [2] Brandt Å, Høeg M & Gjøderum J (September 1994): "A Model for User Influence in Standardization". Final Report from TIDE HEART study, Line A, Workpackage A.3. Århus.
- [3] ETR 116: "Human factors (HF); Human Factors guidelines for ISDN Terminal equipment design".
- [4] ETR 166: "Human Factors (HF); Evaluation of telephones for people with special needs; An evaluation method".
- [5] ITU-T Recommendation E.161: "Arrangement of figures, letters and symbols on telephones and other devices that can be used for gaining access to a telephone network".
- [6] reserved for *ISO 9241-4: "Ergonomic requirements for office work with visual display terminals (VDTs) - Part 4: Keyboard requirements"* not yet available.
- [7] "Telephones for All, Nordic Design Guidelines", NNH 3/95, The Nordic Committee on Disability, Stockholm, 1995.
- [8] ETS 300 640: "Human Factors (HF); Assignment of alphabetic letters to digits on standard telephone keypad arrays".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of this ETR, the following definitions apply:

function keys: Specific keys or push-buttons that provide access to telephonic functions other than the basic numeric keys. For example the repeat key, memory key and hands-free key.

hands-free function: Function on a telephone which makes it possible to make a telephone call without having to hold the handset during the call.

hands-free key: The key or push-button used for activation of hands-free function.

keyboard: The collection of numeric, alphanumeric and function keys on a telephone.

keypad: The numeric keys 0 - 9, star (*) and square (#). See ITU-T Recommendation E.161 [5].

memory function: Function on telephone where several telephone numbers are pre-programmed so that they may be dialled by one or more key strokes.

memory key: The function key or push-button used for activation of the memory function.

multiple activation: Activation of a function by one or more sequential keystrokes (of a single key or of two or more keys), or by two or more simultaneous keystrokes on separate keys (e.g. similar to a chord action).

recall key: The function key or push-button used to activate the register recall function.

register recall function: The function on a telephone which enables a user to send, during a call, a recall signal to the local exchange.

repeat function: Function on telephone where the last called number may be called again by one or two key strokes, also known as *redial* or *last number dial*.

repeat key: The function key or push-button used for activation of the repeat function.

pitch: Distance from key centre to key centre.

single activation: Activation of a function by only one keystroke.

3.2 Symbols

For the purposes of this ETR, the following symbols apply:

*	The Star on the standard telephone keypad arrays, see ITU-T Recommendation E.161 [5]. Also known as the asterisk.
#	The Square on the standard telephone keypad arrays, see ITU-T Recommendation E.161 [5]. Also known as the hash, number or sharp sign ("pound" in the USA).
R	The symbol for Register Recall, see ITU-T Recommendation E.161 [5].

3.3 Abbreviations

For the purposes of this ETR, the following abbreviations apply:

COST	European Co-operation in the field of Scientific and Technical Research
HEART	Horizontal European Activities in Rehabilitation Technology
RACE	Research and development in Advanced Communications technologies in Europe
TIDE	Technology Initiative for Disabled and Elderly People

4 Recommendations for the characteristics of telephone keypads and keyboards

Telephone keypads and keyboards are currently - and will be for a considerable time to come - the basic means for providing access to telecommunications services in most telecommunications equipment. It is important, therefore, that telephone keypads and keyboards are designed in a way so that they are easy to use for most people, including the elderly and disabled. This impacts the design requirements for the physical characteristics of the keypad and keyboard.

A small set of recommendations for these characteristics is presented below. Some of these have been extrapolated from a user panel test involving a number of elderly and disabled users. In cases where no recommendations could be extrapolated because the user panel test did not provide sufficient evidence, such as the force needed to press down the keys and the characteristics of the snap-action, recommendations have been included from other sources.

These include:

- "Telephones for All, Nordic Design Guidelines" [7];
- ETSI ETR 116 [3];
- ETSI ETR 166 [4];
- ISO 9241-4 [6].

It is important to see the recommendations in a comprehensive way because the usability may depend on a number of factors. For example, the readability of the characters on the top of the keys is dependent on height of character, contrast, shape of the top of the key and on the material of the keys.

4.1 Keypad layout

To meet user expectations, it is important that the layout of telephone numeric keypads comply with ITU-T Recommendation E.161 [5], and use the standard 3 x 4 (12 key) keypad array.

4.2 Size of keys

Large keys are an advantage to many elderly and disabled people, because large keys can help the user press the key correctly. However, if the keys in the numeric keypad are too large it may cause problems for blind people, as it may contravene their expectations with respect to the individual key's position. Function keys may be more difficult to find and activate than numeric keys, because they are not included in the standard keypad layout. Therefore, function keys should be easy to distinguish from the numeric keypad. One way to do this is for the function keys to be larger than the numeric keys.

Recommendations

- The top of numeric keys should have a surface area of about 150 mm², with a minimum dimension in any direction of 12 mm.
- The top of function keys should have a surface area of between 150 and 350 mm², with a minimum dimension in any direction of 12 mm.

4.3 The space between each key

It is easier for people with uncoordinated movements to press the correct key, and easier for blind and visually impaired people to identify each key, when there is sufficient space between the keys. There is some evidence that for the numeric keypad a slight increase in key spacing over the recommendations included in ETR 116 [3] may help the elderly and disabled. However, this may also impact the user's keying accuracy and keying speed.

Recommendations

- The pitch of the keys in the numeric keypad should be 19 ± 1 mm.

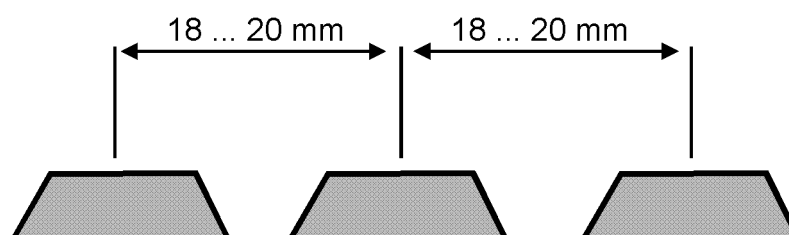


Figure 1: The pitch between keys measured from key centre to key centre

4.4 Separation of key groups

In order to help visually impaired and blind people identify the various key groups, it is important that they can distinguish between the groups by means of a distinct tactile indication.

Recommendations

- Key groups should be separated by a clearly defined space. This space should be distinguishably larger than the inter-key space used within any of the adjacent key groups. For preference, the shape as well as the size of the keys should be used to help distinguish between the different key groups.

4.5 Shape of keys

The shape of the plan view of the key does not noticeably effect the keying ability of elderly or disabled people. The key shape, in plan view, may therefore be round, square, oblong, oval, etc.

4.6 Key tops

Concave sculptured key caps are preferable as they help the finger to locate the centre of "resistance". Convex rounded key caps make the fingers slip off the keys and may cause specular reflections so that it is difficult to read the character on the top of the key. A tactile raised "dot" on the "5" key of the numeric keypad helps blind and visually impaired people locate the numeric keys.

Recommendations

- Concave sculptured key caps are preferable, and flat key caps are acceptable.
- The top of the "5" key should have a tactile identifier e.g. a raised "dot".

4.7 Height of characters on the keys

The character should be as large as possible within the limits of the top of the keys, because large characters are easier to read. Letters assigned to numeric keys should not interfere with the legibility of the numbers on the keys (see ETS 300 640 [8]).

Recommendations

- The height of the characters on keys should preferably be over 7,5 mm. The lower case letter height ("x") should be no less than half of the upper case ("X") character height.
- There should be at least 1 mm between the character and the edge of the key.
- A sans serif typeface should be used.

4.8 Contrast between characters and keys

The visual contrast between the key background colour and the colour of the legend should be as high as possible since this enhances the readability of the characters considerably.

Recommendations

- The contrast ratio between the colours of the label and of the key should be greater than 10:1.

4.9 Contrast between keys and telephone set

In order for visually impaired people to identify keys, it is recommended that there is a clear visual contrast between the keys and the telephone set.

Recommendations

- The contrast ratio between the colour of the keys and the colour of the telephone casework should be greater than 3:1.

4.10 Key material

The material of the keys should not cause glare and not be slippery. Furthermore, the surface should feel smooth, so that it is not uncomfortable for blind people to slide their fingers over the keys in order to identify them.

Recommendations

- The surface of the keys should be matt, with a specular reflectance of less than 45 % and with a diffuse reflectance between 20 % and 50 %.

4.11 Tactile feedback and ease of keying

It is important, especially for visually impaired people, to be able to feel exactly when a key is activated. Keys with snap-action give tactile and auditory feedback. If keys do not activate easily and clearly (irrespective of where on the key top the pressure is applied), people with little muscular strength may have difficulty in activating the keys.

Recommendations

- Choose snap-action keys, i.e. when the key is activated, a noticeable "click" should be felt and heard from it. This should be as distinct as possible.
- The key travel (press and release) should be smooth.

4.12 Angle of keypad

When using desk-top telephones, people who need to rest their hands, wrists or forearms may have difficulties when dialling if the angle of the keypad is too steep, or the front of the telephone casework is too high. On the other hand, if the keypad is too flat it may be difficult to read the characters on the keys.

Recommendations

- The height of the front edge of a desk-top telephone should not exceed 30 mm.
- The tilt angle of the keypad on desk-top telephones should be between 10° and 20°.

See figure 2.

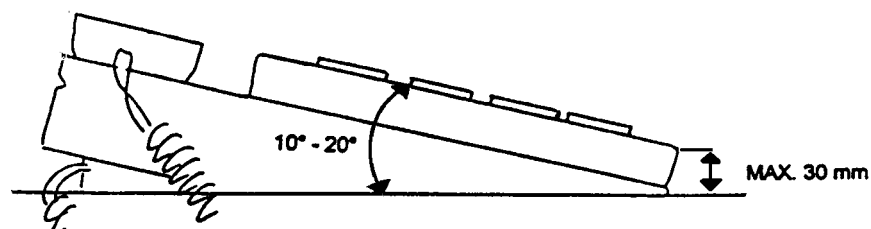


Figure 2: Tilt angle of the keypad and maximum height of the front of the telephone

4.13 Labelling of function keys

It can often be difficult to determine the proper use of some function keys, especially if they are labelled with unknown symbols, abbreviations, or in a foreign language.

Recommendations

- Function keys should be labelled with the full function names in the national or preferred language, or by well-known symbols. If there is insufficient space, easily understandable abbreviations may be used.
- Symbols should be supported by a prompt card or other user guidance material identifying the function shown in the symbol and providing the equivalent label or description in the preferred language.

4.14 Activation of functions

If the repeat function or the memory function is activated by more than one keystroke (i.e. multiple activation, either sequential or simultaneous) it may often be easier to redial the whole number.

Recommendations

- The redial function should be activated by a single keystroke.
- It should be possible to activate some of the memory keys by a single keystroke.

4.15 Labelling of memory keys

In order for the user to remember which number is stored under which memory key, it is important that unambiguous labelling is available.

Recommendations

- Single activated memory keys should be provided with a means for the user to indicate the function, number or name accessible via each such key.

Annex A: Bibliography

ETR 029: "Human Factors (HF); Access to telecommunications for people with special needs Recommendations for improving and adapting telecommunication terminals and services for people with impairments".

ETR 051: "Human Factors (HF); Usability checklist for telephones Basic requirements".

ETR 095: "Human Factors (HF); Guide for usability evaluations of telecommunications systems and services".

"Issues in Telecommunication and Disability". COST 219, 1991.

"Use of telecommunication: The needs of people with disabilities. European Co-operation in the field of Scientific and Technical Research". COST 219. 1989.

"Accessible design of consumer products. Guidelines for the design of consumer products to increase their accessibility to people with disabilities or who are ageing. Working draft 1.6". December 1991. Trace R&D Centre, Madison, Wisconsin, USA.

Sandhu, J., Wood, T.: "Demography and Market Sector Analysis of People with Special Needs in Thirteen European Countries: A Report on Telecommunication Usability Issues". Report for RACE project R1088 TUDOR. 1990.

"Eldre og selvbetjent teknologi". Human Factors Solutions. Oslo 1992.

ISO 1092: "Adding machines and calculating machines - Numeric section of ten-key keyboards".

ISO 9995: "Information Technology; Keyboard layouts for text and office systems" (eight parts).

Hine NA (1992): "People with Special Needs and Service access", in "Integrated Broadband Communications: Views from Race, Usage Aspects", Byerley P & Connell S (Eds.), Elsevier Science Publishers B.V., North-Holland, pp. 201-230.

History

Document history	
January 1997	First Edition